

**ENERGY ENGINEERING  
ANALYSIS PROGRAM (EEAP)**

**BASSETT ARMY COMMUNITY  
HOSPITAL  
FORT WAINWRIGHT, ALASKA**

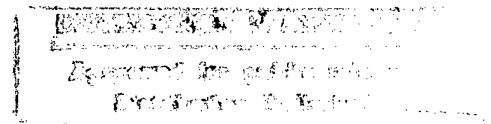
**FINAL SUBMITTAL**

**NOVEMBER 15, 1985**

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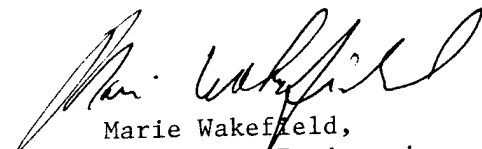


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**II. EXECUTIVE SUMMARY**

**1. Introduction**

1.0 This energy audit and analysis of Bassett Army Community Hospital has been prepared for the Alaska District, Corps of Engineers and is structured to meet the requirements of the Energy Engineering Analysis Program (EEAP).

1.1 The scope of work under Contract No. DACA85-84-C-0018 is to provide a complete energy audit and analysis of the Hospital, Building 4065, including an hourly computer building simulation to model the energy performance of the building as well as the interactive and synergistic responses of the building and systems to recommended improvements. In addition to the above, a complete survey of all energy-consuming systems in the building is to be made to determine the condition of the equipment, operational procedures, adequacy of plant capacities and identify opportunities for efficiency improvements and heat recovery. Also to be evaluated is the potential savings of installation of and Energy Monitoring and Control System (EMCS), that would be stand-alone, but interface with any future base-wide EMCS.

1.0.03 Documents included in this submittal will only be changed to comply with comments made during the prefinal conference. Volumes issued should be retained.

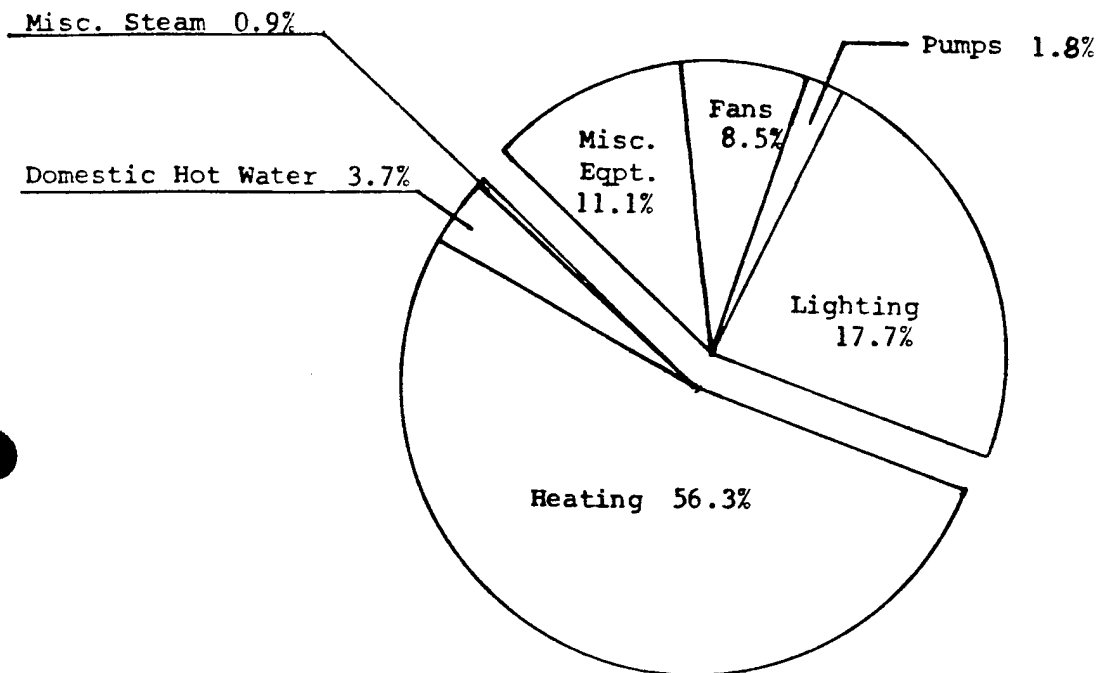
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2.0 Present Energy Consumption

- 2.0.01 The estimated energy consumption of Building 4065 is 617,000 BTUs per square foot per year. This figure represents the energy produced at the Central Heating and Power Plant and includes generation efficiencies, distribution and conversion losses. The net energy consumed at the hospital before conversion and losses is 31,069,884 pounds of steam and 2,280,011 KWH of electricity per year. It must be remembered that all energy consumed at Fort Wainwright, whether electric or steam, results in the consumption of coal by the Central Heating and Power Plant. All energy indices determined in this study are ultimately converted to Millions of BTUs of coal for comparison and economic analysis.
- 2.0.02 Figure 1 on the following page is a graphical breakdown of the relative energy consumption by component in Building 4065. As can be seen, the 56.3% of the energy consumption goes to heat the building. The next largest consumer of energy is the lighting at 17.7%. Miscellaneous electrical equipment accounts for 11.1 %, fans for 8.5% and Domestic Hot Water for 3.7%.

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**ELECTRICAL CONSUMPTION**



**STEAM CONSUMPTION**

**FIGURE 1**  
**Bassett Army Hospital**  
**Breakdown of Annual Energy Consumption**

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3.0 Historical Energy Consumption

3.0.01 The historical energy consumption of Building 4065 is not known precisely. The building is not metered for steam or electrical consumption. A previous study by Grumann estimated the energy consumption at 533,900 BTUs per square foot per year, but without metering, consumption cannot be precisely determined. Several discrete tests of steam flow through the condensate pump were made under different outside temperatures and show good agreement with the computer model constructed for this facility. We believe the energy consumption to be on the order of 650,000 to 700,000 BTUs per square foot per year.

4. Operation and Maintenance Improvements

4.1 The building survey in section C describes in detail many of the conditions encountered on the site visits. As stated elsewhere in this report, it is important to correct the existing system problems prior to implementation of energy conservation measures. In the case of this building, the O & M measures will result in an increase in energy use. The building, as designed, is just marginally providing four air changes of ventilation. This is the minimum ventilation rate for any area within a hospital according to TM 5-838-2. Currently the hospital is getting approximately half the design ventilation as shown on original design documents. Air quantities should be up to design levels as a minimum.

4.2 Emergency measures are described in the letter to the Alaska District Army Corps and are included in Appendix B, dated March 13, 1985. Recommended O & M measures are as follows:

4.2.01 Air System:

1. Remove (and replace) the sagging duct liner on the upstream side of the Recirculating Fan.

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2. Clean and "comb" fins on all preheat and run-around coils.
3. Install filters on upstream side of surgery preheat coils and main system run-around coils.
4. Seal leaks in penthouse supply ductwork
5. Balance all air systems to recommended or design air quantities.

4.2.02 Heating System

1. Clean perimeter convector heater coils.
2. Calibrate convector heaters
3. Educate staff as to proper seasonal operation of convector heaters.

4.2.03 Steam System

1. Repair Valve Leaks in Basement PRV Station area.
2. Repair/replace condensate pump leaks

4.2.04 Lighting

1. Begin use of lighter paint in offices, corridors and waiting areas.
2. Delamp library and isolated classrooms and conference rooms on the extreme east and west ends of each floor to reduce footcandle levels to those recommended in Table II, Section III C, pg. 25.
3. Begin stocking low energy lamps and ballasts
4. Consider use of lighter colored floor tiles in future projects

4.2.05 Air Conditioning System

1. Reset condenser water temperature to 80 degrees.

- 4.3 With the exception of the lighting recommendations, computer simulation inputs for Energy Conservation Opportunity measures are based up the assumption that the above measures are performed.

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5. Energy Conservation Analysis

5.0 ECOs Investigated

5.0.01 Of the potential ECOs suggested in Annex A of the project scope and the many investigated during site visits to the facility, the following appeared promising enough to model their impact on the facilities energy consumption in the building computer energy simulation. Cost estimates were made to fiscal year 1988, as required in the scope of work. This was done to ensure that results would meet ECIP criteria if the larger projects qualified. The ECOs are listed in descending order of S.I.R. and also include capital cost, first year savings and simple amortization period.

5.0.02 ECO No. 1: Time Clock Operation of Exhaust Fans

The main kitchen exhaust hood exhaust, serving line exhaust and dishwasher exhaust were all found to be in operation 24 hours per day. While switches exist to turn them off, subsequent visits showed that staff were not using them regularly. Two small outside air fans in the basement also run 24 hours in an area with an occupancy of 10 hours per day. This ECO requires installation of five time clocks to turn these fans off during unoccupied periods. The savings result in less fan energy and less lost building heat.

Capital Cost	\$ 4,572
Energy Savings (MBTU)	3,820
First Year Dollar Savings	13,981
SIR	37.6
Simple Amortization Period	0.33 Years



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5.0.03 ECO No. 2: Garage and Entrance Door Weatherstripping

This measure would replace the weatherstripping around the four garage doors and two frequently used building entrance areas. Savings result from less infiltration into the main corridors.

Capital Cost	\$ 1,156
Energy Savings (MBTU)	172
First Year Dollar Savings	629
SIR	6.69
Simple Amortization Period	1.84 Years

5.0.04 ECO No. 3: Convector Heater Cover Modifications

The convector heaters are difficult to adjust and very few of the hospital staff know how they work. This measure would install an access door in each convector cover so it could be adjusted without removing the heavy cover. Permanent plastic-covered instructions would be mounted in the vicinity of the door, so no operation training would be required.

Capital Cost	\$43,166
Energy Savings (MBTU)	2,184
First Year Dollar Savings	22,619
SIR	4.54
Simple Amortization Period	1.91 Years

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5.0.05 ECO No. 4: Power Factor Correction

Bassett Hospital does not have many large motors, but most of the motors used by the distribution systems are in operation 24 hours per day. While there is no power factor penalty imposed, the base power plant is the direct beneficiary in improved power factor, which translates into less electricity that must be generated. This measure assumes capacitors are installed on all motors 5 H.P. and greater that are in constant operation.

Capital Cost	\$ 9,467
Energy Savings (MBTU)	949
First Year Dollar Savings	3,474
SIR	3.17
Simple Amortization Period	2.73 Years

5.0.06 ECO No. 5: Install Water Flow Restrictors

This ECO requires the installation of plastic disk water flow restrictors on 127 sink fixtures and 42 showers. Flow restrictors can reduce the flow of a 1.5 GPM fixture to 0.5 GPM and a 5.0 GPM shower fixture to 3.0. Savings are gained in reduced hot water consumption and reduced overall hot and cold water consumption.

Capital Cost	\$ 3,135
Energy Savings (MBTU)	703
First Year Dollar Savings	2,573
SIR	2.93
Simple Amortization Period	1.22 Years

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5.0.07 ECO No. 6: Insulate Basement Ceiling and Steam Valves

The basement is overheating most of the year. The excess heat comes from uninsulated steam valves in the vicinity of the PRV Station. Several hot water lines also require insulating in this area. Additionally, there is an uninsulated concrete floor between this hot area and the freezers in the kitchen. This causes additional compressor energy consumption by the freezers to reject this additional heat back to the basement.

Capital Cost	\$14,206
Energy Savings (MBTU)	683
First Year Dollar Savings	2,500
SIR	2.16
Simple Amortization Period	5.68 Years

5.0.08 ECO No. 7: Kitchen Exhaust Heat Recovery

The kitchen exhaust fan is located in the vicinity of the Surgery Fan in the hospital penthouse. This ECO requires the installation of a run-around heat reclaim system that would transfer wasted exhaust heat through coils and a glycol loop to outside air coming into the surgery fan system.

Capital Cost	\$31,352
Energy Savings (MBTU)	1,212
First Year Dollar Savings	4,436
SIR	1.74
Simple Amortization Period	7.07 Years

5.0.09 ECO No. 8: Install High Efficiency Motors

This measure would require the installation of high efficiency motors on the larger fans that are in constant operation. Lower electrical consumption and improved power factor are the benefits of this ECO.

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Capital Cost	\$16,670
Energy Savings (MBTU)	434
First Year Dollar Savings	1,589
SIR	1.17
Simple Amortization Period	10.5 Years

5.0.10 ECO No. 9: Weatherstrip Windows, Garage Doors & Entrances

The intent of this ECO was to take ECO No. 2 a step further and include weatherstripping of all 576 hospital windows. The measure did not prove to be cost effective, for the most part because of the low average wind velocities in the Fairbanks area and the fact that the double windows already have a good seal.

Capital Cost	\$70,848
Energy Savings (MBTU)	809
First Year Dollar Savings	2,961
SIR	.51
Simple Amortization Period	23.9 Years

5.0.11 ECO No. 10: New Convactor Control Valves & Remote Thermostats

This ECO represents a controls solution to the overheating problem described in the discussion under ECO No. 3. Locating wall mounted thermostats in each heater zone that set to a temperature rather than modulate flow, and within easy access of patients and staff provided the best overall heating savings of any ECO. Savings in energy were not enough to offset the high mechanical costs of this measure.

Capital Cost	\$1,110,984
Energy Savings (MBTU)	10,029
First Year Dollar Savings	36,706
SIR	.29
Simple Amortization Period	30.3 Years

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5.0.12 ECO No. 11: Install Multiple Level Light Switching

This measure would install multiple switches in areas of the hospital that can take advantage of natural light. The principle is that staff can voluntarily reduce the lighting consumption at times of the day when it is not needed. Assumptions were made that compliance of staff could be anticipated. Even so, the measure does not prove cost effective. As with the other lighting measures, this ECO is attempting to improve on a reasonably designed lighting system that already has lower energy lamps and ballasts in place.

Capital Cost	\$24,374
Energy Savings (MBTU)	171
First Year Dollar Savings	513
SIR	.26
Simple Amortization Period	47.5 Years

5.0.13 ECO No. 12: Light Delamping and Floor Tile Replacement

It has been demonstrated in this study that the corridor and assembly area lighting could be reduced by more than 25 percent by removal of fixtures, if the floor tile color scheme were changed. The hospital currently has dark green floors, and currently there is a project underway to replace those tiles with dark brown tiles. This project could not pay for new floors. If the tile color could be changed in replacement projects already funded and underway, installed lighting could be reduced.

Capital Cost	\$211,505
Energy Savings (MBTU)	1,190
First Year Dollar Savings	4,356
SIR	.25
Simple Amortization Period	48.6 Years

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5.0.14 ECO No. 13: Install Insulated Shutters

This ECO assumes the installation of insulated shutters that could be closed over the windows during periods of darkness to reduce heat loss through the windows. Assuming full staff compliance, this measure did not prove to be cost effective.

Capital Cost	\$188,973
Energy Savings (MBTU)	684
First Year Dollar Savings	2,504
SIR	.16
Simple Amortization Period	75.5 Years

5.0.15 ECO No. 14: Occupancy Sensor Switching of Lights

The intent of this ECO is to shut off office and exam room lights when unoccupied. While this is finding successful application in new construction in some parts of the United States and Canada, the savings as a retrofit measure could not justify the large first costs.

Capital Cost	\$131,001
Energy Savings (MBTU)	435
First Year Dollar Savings	1,592
SIR	.15
Simple Amortization Period	82.3 Years

5.1 ECOs Recommended

- 5.1.01 ECOs 1 through 8 individually are cost effective by life cycle cost criteria, however the principle of diminishing returns shows that the individual savings of the measures is greater than the savings of a combination of measures. For example, if we turn the kitchen exhaust fan off at night, we reduce the savings the run-around coil in the heat recovery ECO. One of the benefits of modeling the effects of the various measures on an hourly computer program is that these interactive effects on combined ECOs can be modeled.

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- 5.1.02 All qualifying ECOs (1-8) were recommended for project implementation with the exception of the flow restriction (ECO No. 5) which hospital and base staff have had difficulty with in the past.

6. Energy Plan

6.0 Project ECO Package - ECOs 1, 2, 3, 4, 6, 7 and 8

The project package consists of Fan Time clocks, entrance and garage weatherstripping, convector cover modification, high efficiency motor/motor power factor correction, basement insulation, and kitchen exhaust heat recovery. This package in its entirety is recommended for implementation. Programming documents are contained in Volume II of the report.

Capital Cost	\$ 120,587
Energy Savings (MBTU)	8,830
First Year Dollar Savings	32,318
SIR	3.29
Simple Amortization Period	3.7 Years

- 6.1 Figure 2 on the following page is a bar chart representation of cumulative savings of alternatives studied. These savings are documented and tabulated in Tables I and II following.

7. Energy and Cost Savings

- 7.0 Incorporation of all recommended ECO packages will result in a net savings of 8,830 MBTU per year, or \$32,318 per year. Total building energy consumption is reduced from the O & M incorporated base case of 93,749 MBTUs per year to 84,918 MBTUs per year, representing a reduction of more than 9 percent of the total energy consumption.

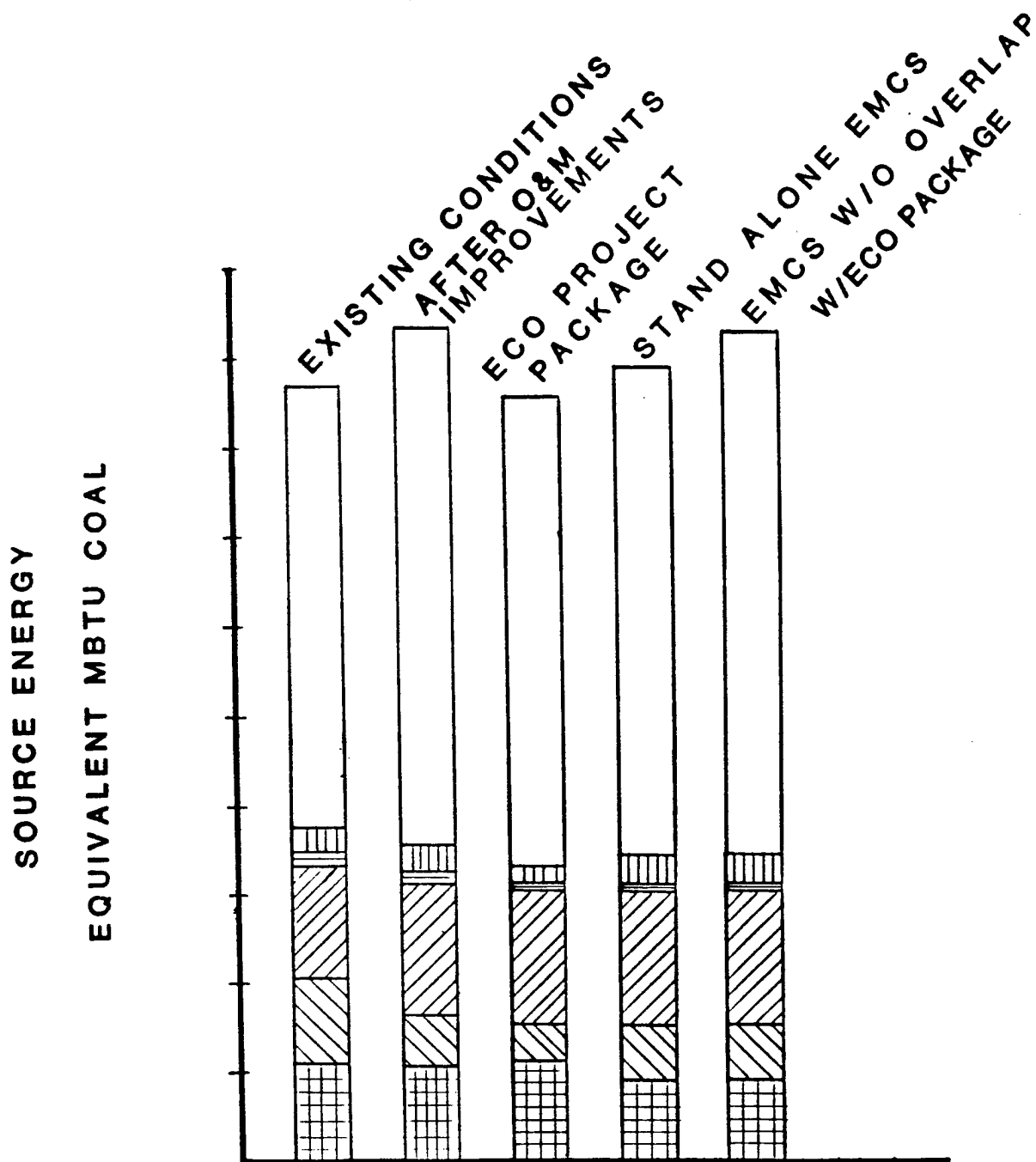
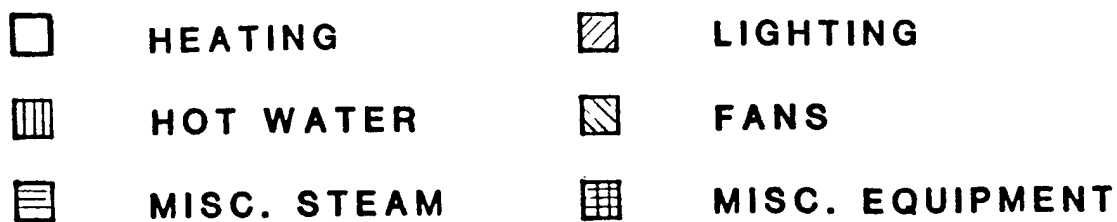


FIGURE 2 - COMPARISON OF ENERGY SAVING PACKAGES







EXISTING CONDITIONS	ECO NO. 1 INCORPORATE BEST/USUALLY O & M FAN THRESH	ECO NO. 2 DOOR STRIPPING	ECO NO. 3 CONNECTOR HEATER ACCESS PANEL	ECO NO. 4 POWER FACTOR CORRECTION	ECO NO. 5 HOT WATER FLOW RESTRICTIONS	ECO NO. 6 INFLATE BENT & VOLT STEAM LINE & CEILING	ECO NO. 7 HIT EDR MT REDD	ECO NO. 8 HIGH EFFICIENCY MOTORS	ECO NO. 9 DOOR/ROOM WEATHER-STRIPPING	ECO NO. 10 CONNECTION CONTROLS	ECO NO. 11 MULTI LEVEL SWITCHING	ECO NO. 12 DELAY PAINT CELLARS, WALL REPLACE FLA TILE	ECO NO. 13 INSULATED WINDOW SHUTTERS	ECO NO. 14 OCCUPANCY SENSORS	STAND ALONE SVC PACKAGE	SPKS NOT OVERLAPPING EDS PROJECT FUNCTIONS	CONSTRUCTION ED NO. 1 AND ED NO. 7	CONSTRUCTION ED NO. 4 AND ED NO. 8	ED
HEATING: (BTU)																			
PRIMARY	-2,176,936	1,633,917	93,254	-785,228	0	-1,644,238	928,845	0	436,845	-4,192,391	-8,117	-73,148	382,185	-28,136	1,634,578	23	2,489,319	0	1,644,889
SECONDARY	-44,628	0	0	-11,688	0	0	235	0	343	-132,877	0	0	241	0	0	0	-445,976	0	-445,152
SUPPLEMENTAL	0	0	0	1,934,143	0	0	0	0	0	9,878,611	0	0	0	0	0	0	0	0	1,934,143
PRE-HEAT	-2,833,843	914,786	0	0	0	0	0	0	0	0	0	0	0	0	914,786	0	914,786	0	914,786
TOTAL HEATING	-5,054,857	1,538,703	93,254	1,217,227	0	-1,644,238	928,388	0	436,488	5,325,233	-8,117	-73,148	382,346	-28,136	1,751,564	23	2,478,329	0	3,638,777
COOLING: (TON-HRS)																			
PRIMARY	-1,782	0	0	-1	0	0	199	0	-41	-2	0	0	-39	0	0	0	194	0	3,882
SECONDARY	9,723	-71	185	9	0	0	0	0	576	-14	71	244	-878	155	-71	0	-71	0	25
TOTAL COOLING	8,621	-71	185	8	0	0	199	0	535	-16	71	244	-988	155	-71	0	123	0	3,786
ELECTRIC: (KWH)																			
FANS	118,868	0	0	0	0	0	-11,126	29,349	0	0	0	0	0	0	0	0	-11,126	78,883	78,883
ELECTRIC BASE	122,358	18,372	0	0	0	33,539	-31,331	29,348	0	0	19,433	91,349	0	32,728	81,713	62,888	-18,187	78,318	94,491
(INCLUDES PACE)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26,144	0	1,584	0
ELECTRIC CLG ACC	0	0	0	0	0	0	118	0	483	-48	44	193	-879	131	2,635	2,693	36	881	76
ELECTRIC CLG	3,449	-46	89	3	861	0	0	0	0	0	0	0	0	0	0	0	0	0	296
INDIRECT PROCESS (BTU)	0	0	0	0	0	436	296	0	0	0	0	0	0	0	0	0	0	0	0
BOILER ENERGY: (BTU)	-5,731	2,298	186	1,354	0	-188	1,438	0	477	4,218	18	-184	432	-32	2,356	379	3,473	0	4,386
TOTAL SITE ELECTRIC CONSUMPTION (KWH)	125,829	18,326	89	3	84,876	0	33,539	-31,213	483	-48	18,477	91,742	-879	32,859	118,489	94,837	-18,151	88,735	95,867
TOTAL SITE STEAM CONSUMPTION (K LBS)	-5,438	2,495	181	1,298	0	415	118	889	0	473	3,722	18	-49	411	-38	2,434	381	2,879	4,383
SOURCE ENERGY CONSUMPTION BY ENERGY TYPE (BTU):																			
ELECTRIC (23 % EFF.)	1,862	271	1	0	949	0	496	-442	434	7	-1	155	1,358	-13	486	1,435	1,344	-289	1,195
STEAM (42 % EFF.)	-9,244	3,549	171	2,184	0	783	187	1,474	0	882	18,038	16	-148	497	-32	4,123	411	4,876	7,423
TOTAL SITE TO SOURCE ENERGY (BTU)	-7,382	3,820	172	2,184	949	783	683	1,212	434	889	18,029	171	1,198	484	435	5,758	1,956	4,587	8,618

TABLE II - ENERGY SAVINGS BY ECO

\* ALL ECO'S COMPARED WITH O&M

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8. EMCS Feasibility

8.1.01 The feasibility analysis for installation of a stand-alone EMCS for Bassett Community Hospital. While installation of an EMCS with the basic architecture described has the potential to save more than 5700 MBTUs per year, the measure did not meet the ECIP criteria. EMCS is most effective when it can optimally start and stop loads in facilities with varying occupancy and system use profiles. Most of the systems and zones at Bassett Hospital are in operation 24 hours per day. Those that are not, are too well integrated into the rest of the system to isolate.

8.1.02 The system is defined as a "Small EMCS" by the guidelines, and consists of a minimum capacity of 78 points, including expansion, one Field Interface Device and three Intelligent Multiplexers. Energy savings overlapped some of the savings obtained in the recommended ECO packages, including timed operation of fans and glycol pump operation by outside air temperature.

8.1.03 Savings consistent with the format of other ECOs are presented below:

Capital Cost	\$ 318,190
Energy Savings (MBTU)	5,758
First Year Dollar Savings	25,277
SIR	.69
Simple Amortization Period	12.6 Years

8.1.04 Based on this preliminary analysis, the Bassett Community Hospital should not be considered for a stand-alone EMCS or for inclusion in any base-wide EMCS system based on energy savings.